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Accounting for heterogeneity in travel episode satisfaction using a random parameters panel effects regression model

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Abstract

Rasouli & Timmermans[1] suggested a model of travel episode satisfaction that includes the degree and nature of multitasking, activity envelope, transport mode, travel party, duration and a set of contextual and socio-economic variables. In this sequel, the focus of attention shifts to the analysis of unobserved heterogeneity in the satisfaction ratings. To that end, some variables included in the original model are randomized, assuming normal distributed random effects The model is estimated using data of a sample of respondents, who judged their satisfaction of every travel episode they experienced during a multi-week data collection effort. GPS devices were used to record their travel and impute activity and travel episodes. A Web-based prompted recall instrument was used to verify and if needed rectify the imputed activity-travel agendas, provide information about the degree and nature of multitasking behavior whilst travelling, and judge the degree of satisfaction associated with the travel episodes. Results of the random parameters regression model evidence a substantial amount of unobserved heterogeneity in the travel episode satisfaction ratings.

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Keywords: Travel episode satisfaction; GPS data; multitasking; activity envelope; random parameters regression model.

1. Introduction

The use of GPS devices and other new technology in collecting travel data has rapidly expanded over the last decade across the world. As evidenced by a collection of field study reports, brought together in Rasouli & Timmermans[2],

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the use of such modern technology has been primary driven by rapidly falling response rates in traditional travel surveys. Expectations are high that GPS devices and GPS-enabled smart phones can reduce respondent burden, and therefore partially or fully replace traditional travel surveys. The ideal is a fully-automated GPS or smart phone study, in which respondents simply agree to participate and carry the device, while their positional data are automatically uploaded to a server to impute a full activity-travel diary, which can then be used to develop activity-based models of travel demand (Rasouli & Timmermans[3]).

The question about the realism of this expectation in the near future is beyond this paper. Regardless of the answer, however, the use of GPS devices may have some inherent advantages, even though respondent burden is not necessarily reduced and consequently response rates are not necessarily improved. What comes to one's mind in this context are studies that require a relatively high degree of accuracy that cannot be provided by conventional paper and pencil travel surveys. Although not perfect, the accuracy of GPS devices in recording distances and particularly time clearly outperforms the accuracy of paper and pencil travel surveys. Subjective assessments of distances and duration are highly sensitive to cognitive distortions, rounding off processes and various mental biases. Consequently, errors will be relatively large, particularly for short trips. Previous research (e.g., Tang & Timmermans[4]) has shown that individuals have major difficulty in re-enacting duration and therefore reporting with a high degree of accuracy the duration of events. Moreover, travel times show day-to-day variation. If individuals have cognitively attached a certain categorical value to a repeated, learned trip, their subjective assessments will not capture the inherent variability in travel times due to their simplified cognitive representations or to the retrieval of their experiences from memory, triggered by the way the question is posed.

To demonstrate the usefulness of GPS data when a high degree of accuracy is needed, this paper reports the design of a study based that combined the use of GPS panel data and a prompted recall instrument, which was used to estimate a model of travel episode satisfaction. This model assumes that judgements/satisfaction of trip episodes are a function of transport mode, travel party, multitasking, activity envelope (activity conducted before and after the trip), socio-economic characteristics and the duration of the trip. Because judgments were obtained for a panel of individuals for every travel episode during a maximum of three months, it was felt critical to be able to differentiate between the true travel times of each travel episode. Moreover, because the disutility of the travel episode is conceptualised to be a negative monotonically decreasing function of duration, it was felt important to have accurate recordings of trip duration. In other words, both travel times and duration require a high degree of accuracy. We argue that for such an application, mobile technologies offer clear advantages over classic paper and pencil travel surveys.

The present paper is a modest sequel to our previous analyses and publications on the topic of trip satisfaction and multitasking, which are all part of a larger, more encompassing project on extensions of current activity-based models of travel demand. First, we started with a conceptual paper, articulating the benefits of travel, which also led to a mathematical specification of the positive utility of travel under multi-tasking (Rasouli & Timmermans[5]). Second, operationalizing this framework, Rasouli & Timmermans[1] formulated and estimated a mathematical model, which relates judgements of travel episodes to duration, transport mode, socio-demographics, travel party, the kind of activity that immediately proceeds and follows the travel episode, and the extent and nature of multitasking. Rasouli[6] elaborated this analysis by systematically comparing three alternative model specifications for representing the functional relationship between the disutility of travel and increasing duration of the travel episode. All these previous papers assumed homogeneity in the judgements of individuals. In this paper, we will challenge this assumption and explore how people differently perceive the effect of different attributes on their satisfaction rate.

In particular, we will estimate a random parameter regression model as an alternative to the previously used conventional regression analysis with panel effects to represent the repeated measurement nature of the data. While assuming that the effects of socio-demographic variables are fixed, all other variables of the previously estimated model are assumed to be random. Rather than estimating fixed effects, the estimated effects are assumed normally distributed.

In reporting the design and results of this study effort, we start with a description of the data collection and the role of the GPS and prompted recall data. This section provides evidence of the power of GPS devices to collect activity-travel information across a longer period of time. Next, we will discuss the formulation and estimation of the random parameters regression model, followed by a discussion of the results. In this section, special attention will be paid to the issue of unobserved heterogeneity. The paper is completed with conclusions and a brief discussion of future research.